

IV. *Practical suggestions and enquiries as to the method of breeding Selenia illustraria for the purpose of obtaining data for Mr. Galton.* By FREDERIC MERRIFIELD.

[Read February 2nd, 1887.]

It being necessary for the purpose of these experiments to bring up in a healthy state nearly all the individuals in every successive brood, instead of merely to obtain a fair number of cabinet specimens,—the usual object of larva-breeders,—more than usual care will be necessary to avoid dwarfing and casualties. No apology, therefore, is offered for submitting the following detailed suggestions,—the result of answers kindly given to many enquiries,—while at the same time further information is invited.

Selection of Species.—The species chosen should be variable in size and easy to rear, pair, and measure; and regularly double-brooded species have the great advantage of reducing by one-half the period required for bringing the experiments to an end. After fully weighing objections, the writer has determined to try a species of which he has considerable knowledge, *Selenia illustraria* (the Purple Thorn), adding to his preliminary experience by practising on the common *S. illunaria*, which appears a month earlier. Other double-brooded species are recommended, viz., the *Ephyras* (especially *E. pendularia*), *Drepana falcula*, and the *Closteras*; among single-brooded moths some of the common and easily bred Bombyces, especially *Hypogymna dispar*, and that variable, interesting, and easily reared Geometer, *Angerona prunaria*. Those who can get over the difficulty of pairing which the butterflies generally present would probably find the common and easily fed and double-brooded *Pieris brassicæ* very suitable.

It is much to be desired that the same species should be taken up by more than one observer, as in this way the accidental failure of a brood may be guarded against,

and provision may be made for occasional cross-breeding to promote the vigour of the breed. Observers living in countries where there is a large choice of double-brooded insects, especially where the climate is such as to admit of three or four broods a year, have great advantages. Under such conditions probably some of the silk-producing Bombyces would be favourable subjects.

Apart from the bearing of the experiments on the theory of heredity to be elucidated, they can hardly fail to throw light on many problems in evolution, such as those which have been investigated by Prof. Weismann, as well as to furnish facts of interest in the life-history of the insects chosen for experiment;—such as the proportion of males and females, and the order in which they appear; the time of the day or night when they emerge from pupa; the time when they are most active on the wing, or in feeding as larvæ; the number of eggs laid; the duration of life in the several stages; the influence of temperature, moisture, and food-plant, &c.;—facts many of which have a general interest for entomologists, but which are rarely recorded with completeness and accuracy by those who only breed for cabinet purposes.

Attention is called to the importance, whatever species is chosen, of starting with a healthy original stock. Pupæ freshly dug or obtained from larvæ found wild, or eggs from moths caught wild, are preferable, as there need be no apprehension that they are suffering under defects engendered by feeding under artificial conditions or by interbreeding. In any case the origin or history of the stock with which the experiments are begun should be known. A supply from a foreign country does not appear to be objectionable, if the species obtained there is known to have the ordinary appearance, size, and habits of the native specimens.

The writer will be greatly obliged to any entomologist, having had practical experience in the rearing of larvæ, for any suggestions tending to ensure success in the experiments determined on. He would be particularly obliged by answers to the following enquiries:—How long can such moths as the *Selenias*, spring and summer broods respectively, be kept alive and quiet, and how can this best be done? Can any better plan be suggested than that of subjecting them to cold and darkness, and

what lowness of temperature will they bear without injury? Are the *Selenias* ever found feeding on flowers, or are they known to feed in confinement? Are the pupæ killed or injured by severe frosts? — Please address replies to 24, Vernon Terrace, Brighton.

APPENDIX.

General Treatment.—For the success of these experiments it seems very important to observe the principle that the insect should, all through its life, be subjected, as far as possible, to the natural conditions in which it exists, while protected from its natural enemies and from casualties. For example, *S. illustraria*, in a state of nature, lives in a much cooler, moister, and fresher air than it does when bred in-doors; its food-plant is exposed to similar influences, to a much stronger light, and its leaves are never in a flagging condition. On the other hand, the wild insect is subject to the depredations of birds, mice, earwigs, beetles, ants, ichneumon flies, and other predaceous and parasitic insects; and is exposed to injury by storms. These considerations point to the following precautions.

Larvæ.—Feed the larvæ, when practicable, on growing trees out of doors, confining them by “sleeves” of the material that most readily admits light and air, but is close enough to keep in the larvæ and exclude insect enemies; muslin, leno, and calico have been recommended for the purpose. This mode of out-door feeding saves some trouble, but does not dispense with frequent supervision, especially in rough weather. The sleeves should be frequently examined; snails and slugs will sometimes eat holes in them. Shelter may be necessary in stormy weather; for this reason, dwarf trees and trees in pots are advantageous. In town gardens a fencing of wire-netting is often necessary as a protection against larger animals. The sleeve should be opened frequently to remove the “frass” and shift the larvæ to fresh quarters, and folds in which the larvæ may get entangled should be avoided. When they are nearly full grown it may be expedient to remove them to a breeding-cage. The larvæ of *S. illustraria* seem to move about in the latter part of the afternoon, but not in general to feed till night. They should not be crowded.

Until the larvæ are so large that they cannot crawl through the interstices of the sleeve they may either be fed on a potted tree in-doors, or, perhaps more safely, in a glass-cylinder, such as is described in books on larva-breeding (Rev. J. Green’s ‘Insect Hunter’s Companion,’ Dr. Knaggs’ articles in the early volumes of the ‘Entomologist’s Monthly Magazine,’ &c.), or in a jar. A simple

and handy one is a jam-pot, with the edge ground down smooth and covered with a piece of very fine muslin, held in place by an elastic-band, and having a piece of plate-glass laid over the top, and occasionally shifted aside for ventilation, and to prevent the formation of drops of water in which the larvæ may drown. Though the pupæ is described as subterranean, it generally spins up between leaves.

If growing trees are not available, the larvæ should be reared in a breeding-cage, standing in a cool airy place out of doors, well supplied with food standing in water-bottles, the necks tightly stuffed with moss, &c. The cage should have a thorough draught, and for the sake of the healthiness of the food-plant it is recommended that the top at least should be of glass. There may be an inch of fine light earth covered with a layer of moss, often renewed. All moss and earth should be baked to kill enemies. *S. illustraria* will eat birch, oak, ash, hawthorn, willow, and alder, but the young larvæ sometimes will not take to all of these, therefore it may be expedient to try them with more than one, and when they are found to thrive on it they should be kept to it. It is stated to be best to cut their food from the same tree and the same side of it. *With the precautions suggested*, and a very frequent renewal of the food-plant, it is believed that the larvæ may be brought up in out-door breeding-cages almost as successfully as by "sleeving" them on growing trees. An occasional moistening of the food with soft water from a scent-spray is useful, especially if the breeding-cage is in an airy situation and the air is dry; but in this case particular care should be taken to remove the layer of moss with the frass and dead leaves collected on it, and at the first symptom of mould or mildew the process should be stopped. All the broods (long-, medium-, and short-winged) should be given the same food-plant and treated in the same way.

Pupæ.—As to the pupæ, it is believed the best way is to keep them out of doors, sheltered from rain, and laid in their slight cocoons on earth covered with moss, and prevented from drying up by placing the box containing them in a situation which will cause the earth to be slightly moist at bottom, or, if this cannot be arranged, by occasional watering with soft water from a scent-spray. Though these pupæ are generally found naturally in dry situations, they are there continually exposed to more or less moist air, and are in the winter rarely removed more than an inch or two from moist earth; and it has been found that if the leaves in which they are spun up become quite dry, the moth has a difficulty in coming out. The pupæ should be occasionally looked at, and a watch kept for insect enemies, including the larvæ of the Tineæ. It would be prudent to protect them against severe frost.

Moths.—Double-brooded moths are very apt to be influenced as to the time of their appearance by temperature. In an unusually warm season if kept out of doors, and in an ordinary season if kept in-doors, some of the moths will sometimes come out, or the caterpillars will spin up too soon, and the moths from them may come out as a third brood. Conversely, if the temperature be very low some of the larvæ of the spring brood will feed up very slowly, and some of the pupæ go over to another year, instead of coming out as a second brood. Any risk of this kind can generally be obviated by moderate watchfulness, and by moving the insects to a cooler or warmer situation, in or out of doors, as may be best. In the South of England *S. illustraria* should appear from the middle or latter part of April through May, and the second brood (its pupa-stage lasting only two or three weeks) in August; any material departure from these dates that may actually appear, or be threatened by the rapid or slow progress of the larvæ, should be counteracted by shifting to cooler or warmer quarters.

Two pairs of each of the sizes (largest-, medium-, and smallest-winged), will probably be enough to produce the required number of eggs, and allow for casualties. After these pairs have been selected and have mated, the rest of the brood should be killed, set, and arranged in a drawer or store-box, according to size, the males and females separately; the breeding pairs, when they have laid their eggs, being set and put in their proper places with the rest, but labelled. Each successive brood will of course be kept separate from all the others. To ensure mating, the pair should be placed in a round bag of muslin, &c., over a fresh spray of the food-plant. A rather warm and moist air seems most conducive to activity in the winged state.

To keep moths long in a living state they should be in a moist air, and have access to honey diluted with water, best supplied by soaking little pieces of sponge in it. A single female of *S. illustraria* may lay 100 eggs or upwards. The female is apt to scatter her eggs over the bag if left in it; if transferred to a jam-pot and supplied with crumpled paper, she will *probably* lay in the creases, which can then be cut out and attached to the food-plant as the hatching period approaches. As it is necessary to preserve all, or nearly all, of a brood of 50 or 100 moths in an unpaired but healthy and vigorous condition till the whole brood is out,—a period which, under ordinary circumstances, may last several weeks, especially with the spring brood,—provision should be made beforehand for this purpose. The males and females should be separated in the pupa-stage (in all the species named they can easily be discriminated by the different appearance of the antennæ, aided by the different

size of the abdomen). As soon as the first moth emerges the remaining pupæ should—without being exposed to a high temperature or to sunshine—be placed in a warm room, and the moths, as they emerge, be placed in a cool moist place, and there be kept in absolute darkness. A refrigerator, or a zinc cover constructed on the evaporating butter-cooler principle, may possibly have to be used here. For convenience in removing the moths without exciting them or injuring their claws, it seems best to place each pupa in a separate chip-box, having a black net lid. This is the course which the writer intends to follow. The moths can be roughly sorted by the eye, but for the sake of greater accuracy a pair of compasses should be used. (*See the remarks on these in Mr. Galton's paper.*) If the species to be measured is small or lively, it may be necessary to temporarily stupify it by placing it under a glass with a few drops of chloroform on blotting-paper.